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SOUTHWEST FISHERIES CENTER

MONTHLY REPORT - MARCH 1977

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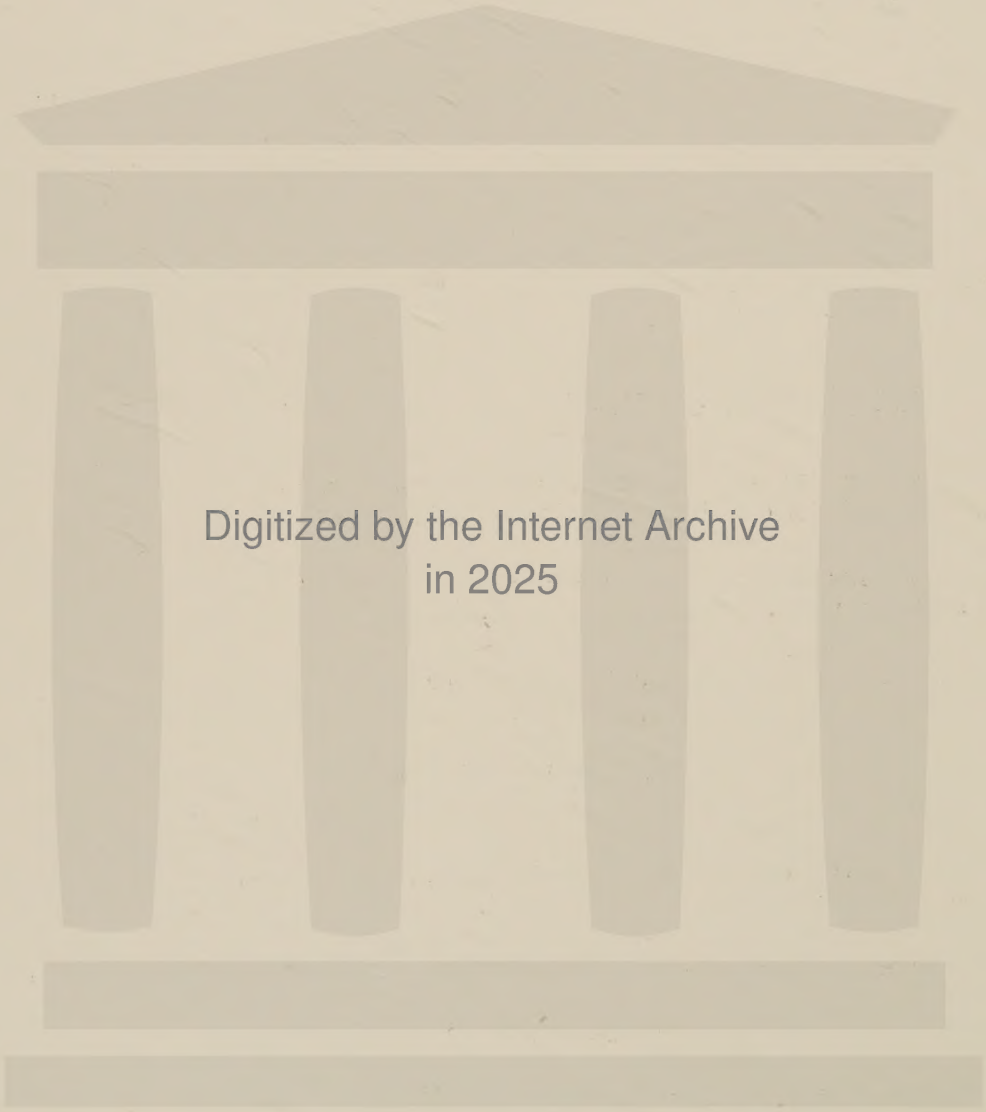

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SOUTHWEST FISHERIES CENTER
La Jolla, California

Honolulu Laboratory
La Jolla Laboratory
Tiburon Laboratory
Pacific Environmental Group

MONTHLY REPORT - MARCH 1977

STATUS OF PUBLICATIONS

Published

McClure, Vance E. 1976. Transport of heavy chlorinated hydrocarbons in the atmosphere. Environ. Sci. Technol. 10(13): 1223-1229.

Polychlorinated biphenyls (PCB) are used to plasticize paints, adhesives, and plastics and are among the most refractory of synthetic organic chemicals. Fluxes of aerosol PCB were measured at La Jolla, California, during February and October, 1972. A model for mesoscale aerosol transport was used with the assumption that deposition occurs irreversibly to compute source strength, aerosol half-life and isopleths of deposition flux. On the basis of flux measurements and model calculations, the author presents arguments for most dry deposition of aerosol PCB introduced into the troposhere to occur within 100 km of the source.

Hewitt, Roger. 1976. Sonar mapping in the California Current area: A review of recent developments. Calif. Coop. Oceanic Fish. Invest. Rep. 18: 149-154.

Some developments in the use of sonar to study pelagic fish schools are reviewed. Techniques for counting the number of fish schools per unit area, measuring their horizontal dimensions, determining their biomass, sizing individual fish within a school, and distinguishing northern anchovy, Engraulis mordax, schools from all others are discussed briefly. Acoustic observations of the distribution, behavior, sizes, and packing density of anchovy schools are reviewed.

This report does not constitute publication and is for information only.

MacGregor, John S. 1976. Ovarian development and fecundity of five species of California Current fishes. Calif. Coop. Oceanic Fish. Invest. Rep. 18: 181-188.

Four different types of ovarian development in five species of fishes are described. The size distribution of the developing eggs suggests that Pacific herring spawns one batch of eggs during its spawning season. The California lightfish and Pacific saury, spawn more than once. The data for jack mackerel and Pacific mackerel proved to be inconclusive. The average number of eggs per gram of fish in a spawning batch was California lightfish, 45; Pacific mackerel, 264; Pacific herring, 277; jack mackerel, 109, California saury, 22.

Ahlstrom, Elbert H. and Elizabeth Stevens. 1976. Report of neuston (surface) collections made on an extended CalCOFI cruise during May 1972. Calif. Coop. Oceanic Fish. Invest. Rep. 18: 167-180.

This is the first report on neuston samples collected during CalCOFI cruises. Some fish spend their young stages in surface waters or migrate into this zone diurnally, particularly at night. For these the neuston collections provide insights that cannot be observed in the standard oblique plankton collections. The neuston net samples some species in far greater numbers than does the standard tow and is an excellent tool for establishing distribution and relative abundances. It also samples a higher proportion of large larvae of some species (northern anchovy, for example) than does the oblique net and so may prove a valuable tool in mortality determinations. The neuston net thus presents interesting potentialities when used in addition to the standard oblique net.

Approved by Center Director

Squire, James L. Jr. "Anchovy fish school shapes as related to problems in school size estimation." For publication in the Fishery Bulletin, U.S.

Hobson, Edmund S. and William H. Lenarz (editors). "Report of a colloquium on the multispecies problem." For Marine Fisheries Review.

Hobson, Edmund S. and James R. Chess. "Trophic relations among fishes and plankton in the lagoon at Enewetak atoll, Marshall Islands." For Fishery Bulletin.

Translation

Suzuki, Ziro and Yukio Warashina. The comparison of catches made by regular and deep-fishing longline gear in the central and western equatorial Pacific Ocean. Far Seas Fish. Res. Lab. Translation from the Japanese of a draft manuscript [received March 1977] provided by the authors. (English translation by Tamio Otsu, Honolulu Laboratory, 1977, 38 p., Translation No. 20.)

HONOLULU LABORATORY

RESOURCE ASSESSMENT AND DEVELOPMENT INVESTIGATIONS (RADI)

Planning and Preparations Continue for Northwestern Hawaiian Islands (NWHI) Cruises

Mr. Richard Uchida, Leader, Insular Resources Task at the Honolulu Laboratory, revised a preliminary cruise plan drafted for the proposed charter of the R/V Easy Rider. Under the agreement reached with Captain Skip Naftel, the Easy Rider will be under charter jointly to the Southwest Fisheries Center, Honolulu Laboratory (Insular Resources Task, and the Northwest and Alaska Fisheries Center, Seattle (Marine Mammals Division). The primary missions of the SWFC portion of the charter will be to assess the pelagic and demersal fish resources in waters around Gardner Pinnacles, Necker Island, and Nihoa Island and to conduct "ghost fishing" and gear competition experiments.

Preliminary planning for TC 77-03 (TC #77) was also begun by Mr. Uchida during the month. This cruise is scheduled for waters of the NWHI from September 5 to November 12. After consultation with several staff members, Mr. Uchida also made tentative selections of monitoring stations in waters throughout the NWHI chain. These stations, at which plankton hauls, mid-water trawl hauls, XBT casts and STD casts will be made, are scheduled to be occupied once every quarter.

Research Assistant Paul Shiota spent most of his time at Kewalo dock-site fabricating fish and lobster traps and a bottom longline to be used on the upcoming cruise of the Townsend Cromwell, Cruise 77-02 (TC #76) to the NWHI.

First Meeting of Western Pacific Regional Fishery Management Council's Scientific and Statistical Committee Held in Honolulu

The initial meeting of the Scientific and Statistical Committee (SSC) of the Western Pacific Regional Fishery Management Council (WPRFMC) was held at the Honolulu Laboratory conference room on February 24 and 25. Chairman of the SSC is Mr. Izadore Barrett, Acting Director of SWFC, La Jolla, and Deputy Chairman is Honolulu Laboratory Director Richard Shomura. All the members of the Committee were present for the first meeting.

After reviewing the guidelines on the structure of the SSC, the Committee began deliberations on identifying the fishery resources that need management plans in the area under the purview of the WPRFMC. Seven fishery resources were identified: (1) pelagic (nonmigratory) resources, including the billfishes, (2) spiny lobsters, (3) precious coral, (4) snappers and groupers, (5) Heterocarpus, (6) carangids, and (7) seamount resources. The Committee also set priorities on the management plans and set the first priority on the pelagic resources (including the billfishes).

The SSC nominated scientific personnel to serve on planning teams to develop five management plans. The chairmen of the plan development teams and the deadline for the first draft of the management plans are:

1. Precious coral - Dr. Richard W. Grigg, University of Hawaii - June 1977
2. Seamount resources - Mr. Richard N. Uchida, Honolulu Laboratory - December 1977
3. Pelagic resources - Dr. Jerry A. Wetherall, Honolulu Laboratory - March 1978
4. Spiny lobster - Dr. Tim D. Smith, University of Hawaii - June 1977
5. Snappers and groupers - Dr. Robert A. Skillman, Honolulu Laboratory - December 1977

The SSC is next scheduled to meet in early May in Honolulu at which time it will review the status of the management plans for spiny lobster and precious coral.

Spiny Lobster Planning Team Begins Work on Management Plan

Dr. Jerry Wetherall, Acting Leader of the Fishery Management Research (FMR) Task at the Honolulu Laboratory, reported that Dr. Tim Smith, Assistant Professor of Zoology at the University of Hawaii, who is chairman of the spiny lobster management plan development team, convened a meeting of the planning team on March 22 to formulate plans for the preparation of a management plan for spiny lobsters. Attendees at the meeting, in addition to Dr. Smith, included Dr. Wetherall, Dr. Roy Mendelssohn, Operations Research Analyst, Mr. Howard Yoshida, Fishery Biologist, and Ms. Kristin Stahl, Research Assistant of the FMR task, all at the Honolulu Laboratory. Also present were Dr. Paul Struhsaker, formerly of the Honolulu Laboratory staff, Mr. Henry Sakuda, Hawaii Division of Fish and Game, and Mr. Craig McDonald, University of Hawaii graduate student.

In the course of the meeting the planning team identified sources of information available or required for the formulation of the management plan and also made assignments of work on various aspects of the plan for individual plan development team members. The team will meet again in 3 weeks to review progress on the management plan.

Status of the South Pacific Longline Fisheries Discussed at PEACESAT Session

Part of the objectives of the Resource Monitoring and Assessment Task at the Honolulu Laboratory, is to monitor the tuna fisheries in the Pacific Ocean and maintain liaison with other tuna researchers and managers in the Pacific to keep abreast of the tuna development activities as well as the status of the tuna stocks. As one means of meeting this goal, Dr. Robert Skillman, Task Leader, has been participating in sessions with other members of the South Pacific community via the PEACESAT satellite communication system. The latest meeting served primarily as a means of exchanging

up-to-date information on the status of the longline fisheries for tunas and billfish that are based in various ports in the South Pacific. In the next session, aspects of managing the longline fisheries will be addressed. Participants in the discussions include Hawaii, Santa Cruz, American Samoa, the Trust Territory of the Pacific Islands, the Solomon Islands, Fiji, New Zealand, and Papua New Guinea, and New Caledonia.

Final Draft of Tripartite Cooperative Agreement (TCA) Completed

The impasse between the State of Hawaii and the U.S. Fish and Wildlife Service has been resolved and a tentative agreement at the field level has been reached on the Tripartite Cooperative Agreement (TCA). The final draft includes a statement describing relevant laws of the State of Hawaii. The complete title of the agreement is, "Survey and Assessment of the Living Resources of the Northwestern Hawaiian Islands, a Tripartite Cooperative Agreement." Copies of the TCA have been sent to the Board of Land and Natural Resources, State of Hawaii, and the Washington offices of the National Marine Fisheries Service, and the U.S. Fish and Wildlife Service for their final review and signature of approval.

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Resource Assessment and Development Investigations (RADI) staff members met with Messrs. Dave Mackett, Center Program Planning Officer and Fred Kellenberger, Center Data Systems Manager, from La Jolla, March 22-24, to determine data information needs of the Honolulu Laboratory. The amount of new data coming in because of the Fishery Management and Conservation Act of 1976 and the resultant enforcement, observer, and assessment activities were discussed. With this new set of data and with the addition of several new data files associated with the NWHI study, the need for placing these data in a data base management system was also discussed, and plans for making such a system operational were outlined.

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Dr. Robert Skillman, as chairman of the Honolulu Laboratory's vessel committee, reported that the cruise plan for the next Townsend Cromwell cruise, TC-77-02, has been completed and circulated according to regulations. This cruise is made up of several segments. Part I (2-7 May 1977) will involve the capture and transport of live tuna specimens to the Kewalo Research Facility for use in physiological and behavioral studies; Part II (8-11 May 1977), the placement and anchoring of fish aggregating objects at three locations off Oahu and either at Peret Seamount or Cross Seamount; Part III (12 May-27 June 1977), resource assessment of the demersal and pelagic fishery resources over seamounts, banks, and offshore grounds of the NWHI from Middle Bank to Hancock Bank; Part IV (1-3 July 1977), monitoring of the fish aggregation objects installed in Part II; and Part V (3 July-17 August 1977), survey and assessment of the nearshore fishery and wildlife resources of the NWHI by the Hawaii Division of Fish and Game,

U.S. Fish and Wildlife Service, and the Honolulu Laboratory, under the terms of the TCA, and a survey of the offshore pelagic fishery resources and planktonic and forage organisms in the offshore waters.

Dr. Skillman also reported that (1) the new cruise schedule for the Townsend Cromwell covering FY 1977-79 has been completed and circulated to interested parties, and (2) the Vessel Committee members met to consider major refurbishing projects for the Townsend Cromwell. A list of the requested projects will be finalized before the site visit of Cdr. Merritt Walter on 14-15 April.

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Fishery Biologist Thomas Hida made a trip to the North Pacific during which, among other things, he participated as an observer on Cruise 77-1 of the Seattle-based NOAA vessel Miller Freeman in Alaskan waters. Mr. Hida observed trawling operations on the Miller Freeman during his 3-week stay on the vessel. He noted that the ship's large complement of 46 officers and crew and up-to-date equipment on the Miller Freeman afforded very efficient trawling operations. While in Seattle, Mr. Hida held discussions on spiny lobster tags with Floy Tag Manufacturing representatives and also finalized arrangements for the shipment to Honolulu of a "Noreastern" trawl and trawl doors.

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Research Assistant James Uchiyama processed and read otoliths of albacore for an age and growth study. Based on 13 data points a preliminary growth model using the von Bertalanffy growth function was obtained. The parameters for the growth model are: $L\infty = 142$ cm; $K = 0.24$; and $T_0 = -0.38$. These data will be available for Dr. Jerry Wetherall's use during the forthcoming albacore population dynamics workshop that will be held in May in Japan.

Mr. Uchiyama also instructed Research Assistant Robert Humphreys in processing and reading otoliths.

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Fishery Biologist Reginald Gooding, who is the supervisor of the foreign-vessel observer program for Honolulu Laboratory, made preparations to place observers on foreign vessels that will be permitted to fish on the seamounts located northwest of Kure Island. These seamounts lie within the 200-mile zone around the Hawaiian Archipelago.

Estimated 1977 Hawaii Landings of Skipjack Tuna Continues Above Long-Term Average

The February 21 to March 27 Hawaii landings of skipjack tuna were estimated at 74 metric tons (MT), which is 169 MT below the 1976 landings for the same period and 68 MT below the 1948 to 1976 long-term average. The 1977 landings from January through March 27 were estimated at 826 MT, which is 343 MT above last year's catch for the same period and 476 MT above the 1948 to 1976 long-term average.

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Pulou Niuatoa, employee of the Government of American Samoa, recorded the lengths of 1,018 albacore landed at Samoa from 29 vessels during the period from February 12 to March 14, 1977. He also collected 40 sets of catch and effort data. Utilizing data from five vessels, the average size of albacore for the period was 94.1 cm and the catch rate averaged 1.30 albacore per 100 hooks.

FISH-ENVIRONMENT INVESTIGATIONS (FEI)

Leader of the Recreational Fisheries Task Participates in New Zealand Billfish Tournament

Heeny Yuen, Leader Recreational Fisheries Task at the Honolulu Laboratory, departed Honolulu on March 16 for New Zealand to participate in the 5th Annual Bay of Islands Billfish Tournament between March 17 and April 6. At the tournament Mr. Yuen measured and examined all the fish caught by tournament participants and also worked on other cooperative projects with fishery biologists in New Zealand.

One of the aims of the Recreational Fisheries Task is to devise a Pacific-wide data collection system for recreational fisheries. In this regard Mr. Yuen will be examining historical catch records maintained by the fishing clubs in New Zealand. He will also make a stopover in Fiji to stimulate interest in data collection on recreational fisheries there.

Experiments Started to Determine Various Behavior Patterns of Tuna

Dr. Andrew Dizon, Leader of the Experimental Ecology of Tunas Task at Honolulu Laboratory, reported that three experiments have been initiated to determine various behavioral patterns of tuna. Mr. Michael Barry started experiments to test the behavior of kawakawa, Euthynnus affinis, in turbid water situations. This work will have relevance in assessing the effects of deep ocean mining discharges on the local, short-term behavior of adult tunas; it will also provide information on the efficiency of natural (or artificial) horizontal stratifications of turbidity acting as a barrier in

purse seining operations in the central and western Pacific. The objective of this initial effort is to devise a workable and rapid testing paradigm that will allow an assay of behaviors of adult tunas encountering discrete areas of increased turbidity.

Preliminary data indicate a multilevel response to turbidity. At a certain level of turbidity, the kawakawa did not enter into a turbid area. At a lower level, the fish entered the turbid area and spent as much time there as in the nonturbid side. However, they did not feed or cross the tank regularly. At low turbidity levels (approximately 2X ambient), the kawakawa crossed between the turbid and nonturbid sides of the tank and fed regularly. However, coughing (or forcing of water over the gills, possibly for cleaning purposes) was seen occasionally even at low turbidity values. Also, the fish did avoid clouds of turbidity (less than 1/2 tank in size) of even the lower turbidities.

In a second outdoor tank, two kawakawa were observed for changes in feeding and other behavior patterns in response to turbidity in the tank. Early results indicated a reduced feeding efficiency and changed swimming behavior consisting of slow swimming in relatively tight schools in turbidities up to 10 times the normal value for that tank.

Research Assistants Randolph Chang and Victor Honda have initiated experiments to determine the maximum sustained swimming speed (defined as the maximum speed a fish can maintain indefinitely) of skipjack tuna. This parameter is basic in determining maximum steady-state energy consumption and metabolic energy production pathways. It also has a bearing on migration rates of skipjack tuna and on fish-scouting strategies.

"Indefinitely" has been defined as any swim speed that can be maintained for more than 200 min and is usually classified as sustained or cruising swim speed. Prolonged or steady swim speeds are those which can be maintained for between 15 sec and 200 min. Burst or sprint speeds exhaust the fish in less than 15 sec. For salmon, anything below 3 lengths/sec is considered sustained. Swim speed performance parameters for skipjack and yellowfin tunas and kawakawa will be determined.

A water tunnel to control swim speed for these fish has been developed. The tunnel is 8 in in diameter and has a test section approximately 3 ft long. Water is drained through the tunnel from the large oceanarium. Fish will be tested with Brett's incremental velocity tests, the end point of which is the critical swim speed. This value closely approximates the maximum sustained swim speed but is experimentally easier to obtain.

To date only one fish has been tested to see how it adapted to the tunnel. A 42 cm skipjack tuna was placed in the tunnel at 1500 h on March 28; it survived throughout the night and the following day. On the morning of March 30, the fish was found with its caudal fin trapped in the

rear screen. (Modifications will be made.) The trapped but living fish was removed, weighed, measured, and its cross-sectional area determined. Swim speeds estimated by Yuen's tail beat rate-swim speed relationship were found to be about 2.0 lengths/sec.

The third experiment was started by Mr. Richard Brill to ascertain the effect of temperature on stasis metabolic rates. The objective of this experiment is to determine how stasis metabolic rate (metabolic rate at zero overt activity) is altered by changes of temperature and whether the changes in metabolic rate correlate best with water or muscle temperatures.

The fish is caught and the spinal cord immediately transected just caudad of the skull. The fish is then placed in the respirometer and firmly restrained. Water for respiration is continuously monitored for dissolved oxygen concentration both upstream and downstream of the respiratory surfaces. Uptake is determined by subtraction. After stabilization of metabolic rate (which indicates that the oxygen debt accrued during capture is repaid) temperature is changed from 25° C to either 30° or 20° C and the procedure repeated.

Fish subjected to a 25° to 20° C change showed a consistent decrease in metabolic rate with a Q_{10} of about 2.0. It was determined that metabolic rate changes follow water temperature changes not muscle temperature changes. Fish subjected to the 25° to 30° C change or the 20° to 30° C change either die or show a very variable response. Metabolic rate becomes very unstable and no consistent pattern emerges.

It is suspected that the metabolic cost of osmoregulation may represent a major proportion of the overall stasis metabolic rate. The metabolic cost of osmoregulation is temperature labile and since the gills are the site of the effects, stasis metabolic rate would be more closely correlated with water temperature rather than muscle temperature. More work is planned.

LA JOLLA LABORATORY

Coastal Fisheries Resources Division

ALBACORE FISHERIES PROGRAM

Oceanographic Instrumentation Monitoring System for Data Collection Designed

At the La Jolla Laboratory Oceanographer R. Lynn designed an "Oceanographic Instrumentation Monitoring System" for data collection aboard the NOAA research vessel David Starr Jordan. This system will monitor and record on-line data input from electronic oceanographic instruments, including

the STD and XBT. It has the potential to be interfaced with the fluorometer, pyroheliometer, thermosalinograph, and salinometer. Additionally, hydrographic casts data will be keyed-in off-line. This system will permit real-time evaluation of recorded data and the capability to analyze data and calibrate instruments at sea. With our present system, data recorded on magnetic tape could only be read ashore and data analysis at sea could only be done after manual digitization of analog charts. Numerous failures have occurred in the magnetic tape recording system in which considerable data were lost. The new system will have the ability to monitor all recorded data during or immediately following each cast.

Central to the monitoring system is the Hewlett-Packard 9825A calculator/system controller. The STD is interfaced to the calculator via a VHF switch and a frequency counter. An A-to-D converter will interface the XBT and other instruments. An interface bus and the priority interrupt feature will allow up to 14 instruments to be on-line.

The monitoring system has been ordered and will be assembled and used on the planned albacore-oceanography cruise in June aboard the Jordan.

Preparations Continue for Albacore/Oceanography Cruise

Dr. Michael Laurs, Leader of the Albacore Fisheries Program at the La Jolla Laboratory, reported that preparations continued this month for the albacore-oceanography cruise in June 1977. During this cruise seven NDBO drifter/drogue buoys will be deployed across the subtropic front in the eastern North Pacific. Data from these buoys will be relayed via the Nimbus 6 satellite to Goddard Space Flight Center. After preliminary computations, Goddard will relay to the Southwest Fisheries Center data on position, sea surface temperature and drogue attachment (attached or lost). Twelve to 18 readings per day per buoy are expected. The batteries should last 6 to 8 months. These buoys will provide velocity, shear, and convergence information over a range of scales. Their initial use will reveal the mini-scale events of the ocean front. Over a longer period mesoscale events will be seen including the flow at the outside of the California Current.

In addition to this new experiment, a hydrographic survey and trolling for albacore will be conducted during the cruise.

LARVAL FISHES, COASTAL EASTERN PACIFIC PROGRAM

Anchovy Larvae Taken to Sea in Test of Inshore Sea Water for Larval Fish Food

Mr. Snorre Tilseth, a Scientist from the Institute for Marine Research, Bergen, Norway, joined the Larval Fish Program at La Jolla for the month of March to observe and participate in the ongoing research. Dr. R. Lasker, Leader of the Coastal Fisheries Resources Division, with Dr. C. Barry, Ms. M. Pollock and Mr. Tilseth grew anchovy larvae to 6 mm, timing their growth

so that the larvae could be used aboard the David Starr Jordan in a test of inshore sea water for adequacy of larval fish food. The March 28 to April 1 portion of a David Starr Jordan cruise was devoted to this experiment. According to Dr. Lasker, almost all of the technical problems of the experiment were solved, particularly those of transporting and transferring the larvae from one container to another and in removing the laboratory food which kept the larvae healthy until they were needed for the bioassay.

Mr. Tilseth spent some time acqainting himself with other facets of research in the program, particularly Mr. Kramer's work on determining the age of larvae from daily rings on the otoliths and Mr. Leong's techniques for maturing and spawning fish.

Tests of various particle counting devices were done on this cruise including Dr. E. Scura's particle rate meter, a new HIAC photo-electric cell counting device, and a Coulter Counter. Unfortunately, the free-fall particle counting device designed by Mr. Jack Brown, Electronic Technician, developed electronic problems at sea and did not function during the cruise.

Arrangements were made by Norwegian researchers to have Dr. Scura join them for a cruise in the Lofoten area of Norway in April to detect food of the larval cod and the fate of fjord-spawned cod eggs.

On the first leg of the Jordan cruise (March 17-28), work was devoted in part to larval fishes and included a test of Dr. J. Hunter's hypothesis that older anchovy larvae come to the surface at night to fill their air bladders. In addition, adult anchovies were caught and frozen immediately in liquid nitrogen to ascertain if they had been eating their own larvae.

At the request of the University of Alaska, Dr. Lasker assisted Dr. Howard Feder of their Institute of Marine Science in developing a program to study larval fish survival in the Bering Sea. Dr. Feder joined the David Starr Jordan for the last 4 days of the cruise to observe the larval fish feeding bioassay experiment. Before Dr. Feder returned to Alaska, Dr. Lasker helped prepare and review a proposal for the maturation and spawning of pollock in captivity to be done at the Seward Marine Laboratory of the University of Alaska in preparation for larval fish studies.

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Dr. Lasker lectured on his most recent research at an Aquatic Ecology Workshop at the University of North Carolina in Raleigh on March 21, and at the NMFS Beaufort Laboratory on March 22. At Scripps Institution, he lectured on his earlier crustacean research to Dr. William Newman's invertebrate class on March 18.

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Dr. John Hunter, Principal Investigator for the Environmental Protection Agency study at the La Jolla Laboratory on the effect of ultra-violet radiation on eggs and larvae of the northern anchovy, Pacific mackerel and other

fishes, reported this month that construction of the roof top solarium for testing effects of UV-B was completed and construction begun on a second unit in the marine aquarium. Other work completed included the calibration of air and water temperature regulation for the solarium, mapping of the distribution of UV-B flux in the solarium, installation of recorders for recording UV-B flux and visible flux, calculation of coefficients to estimate flux in any container. A contract was let for a spectroradiometer.

Ms. Kathy Dorsey, Biological Technician, adding fish eggs to containers for UV experiment in roof-top solarium at the La Jolla Laboratory

Experiments were begun to determine the threshold range of UV-B for embryonic stages of anchovy and mackerel using survival as a criterion and a sunburn meter to measure flux. Histological and morphological examination of larval mackerel and anchovy irradiated with UV-B was started. Preliminary description of the UV-B radiation syndrome includes expansion of melanophores, retardation of development, increase in mitotic divisions, lesions in the brain and eye, lateral-line organs and olfactory epithelium, and a decrease in external pigmentation of the eye.

MULTISPECIES TAXONOMY

Larval Fish Identification Taken on Past Cruises Nearly Completed

Dr. E. H. Ahlstrom, Leader of the Multispecies Taxonomy group at the La Jolla Laboratory, reported work continued on reducing the backlog of CalCOFI samples from cruises made in 1972 and 1975. Only one cruise, 7202, has not been identified and this is being worked on by three persons. During the 1975 CalCOFI year, six extensive cruises were made, usually with about 280 stations occupied per cruise. Larvae from two of these 1975 cruises have been identified and two more cruises are being worked on. At the present pace, all CalCOFI collections made on tri-yearly coverages will be identified and enumerated before the first samples of the 1978 CalCOFI year are available.

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A manuscript dealing with flatfish larvae that are heavily pigmented throughout larval development is being written jointly by Barbara Sumida, H.G. Moser and E.H. Ahlstrom. Heavily pigmented larvae are characteristic of all species of Pleuronichythys, of which four occur in the California Current, and an additional one in the upper part of the Gulf of California. The eggs of Pleuronichthys are quite distinctive, inasmuch as the outer egg shell has a hexagonal pattern. Such polygonal patterns are not known for other flatfishes, but are found on the eggs of Synodontids. The eggs of two of the species of Pleuronichthy contain a small oil globule; the other three species lack this, as do most pleuronectid flatfish eggs. In fact the only other pleuronectid flatfish whose eggs are known to have an oil globule is Hypsopsetta guttulata, another flatfish with heavily pigmented larvae that are dealt with in the manuscript. A local bothid flatfish related to the California halibut, Hippoglossina stometa, also has a heavily pigmented larvae that could be confused with those of Pleuronichthys or Hypsopsetta, especially in early stage larvae. Hence, information is also included on larvae of this species.

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Dr. Ahlstrom has been working with Mr. Dennis Gruber of the Scripps Institution of Oceanography's Food Chain group on nearshore distribution of fish eggs and larvae in the Southern California Bight area. The Food Chain group has occupied three lines of stations in the southern California area during cruises conducted in the past 2 years.

The continental shelf is very narrow in the Southern California Bight area. Even so a number of species spawn in this area. Many inshore species are demersal spawners belonging to such groups as cottids, gobies, blennies, clinids, and pomacentrids. Also, many important inshore fishes spawn pelagic eggs, including sciaenids, many flatfishes, and the ubiquitous northern anchovy. The inshore zone over the continental shelf is the zone most affected by man's activities. The combination of a very narrow continental shelf, the increasing damage by man to their nearshore habitat coupled with increased fishing pressures on many of the nearshore fishes could lead to serious problems. Not enough consideration has been given to the limited area many of the inshore spawning fishes off southern California have, even under natural conditions, and how seriously man's activities can impinge on this area. It is questionable whether the width of the continental shelf has been taken into consideration for onsite locations for atomic power plants, for example.

SURVEY SYSTEMS DEVELOPMENT AND EVALUATION PROGRAM

Resonance Survey of Pelagic Fish Contacts Conducted

Fishery Biologist Dr. Paul Smith and Dr. Van Holliday of the TRACOR Corporation conducted resonance surveys of pelagic fish contacts aboard the NOAA research vessel David Starr Jordan during March in the Southern California Bight. Signals were recorded on magnetic tape for detailed laboratory processing which is now in progress. Instant data processing at sea was successfully accomplished for the first time during this cruise. This capability is used principally for data quality monitoring. A preliminary analysis of acoustic contacts shows that it is possible to discriminate between targets containing gas bladders and those which do not. Among those containing bubbles (swim bladders) a rough estimate of the average bubble can be obtained which permits discrimination between larvae and adult fish.

Contouring Program Developed for Display of Geographical Distribution of CalCOFI Larvae Data

One of the objectives of the Coastal Program is to develop programs to access and display regionally pooled oceanographic and biological data in comparable time scales. In this context, Mr. Butch Burris, Programmer at the La Jolla Laboratory, has completed a computer program to access the

regionally-pooled CalCOFI oceanographic data file and produce tabular outputs of selected variables for selected standard depths by region for individual cruises and long-term means.

A two-dimensional contouring program along with several ancillary graphics routines have been written in BASIC for use on mini-computers with graphics capability. The programs were developed primarily for displaying geographical distributions of CalCOFI larval data by month, quarter, and year for selected species and size classes. They can be used, however, for contouring any scalar field defined by a two-dimensional array of values representing evenly spaced points on a rectangular grid. Modifications currently in process will add a zoom capability so that sub-areas can be selected and expanded to resolve small scale features.

COMMERICAL AND RECREATIONAL FISHERIES RESEARCH FOR MANAGEMENT PROGRAM

Team Recommends Central Anchovy Stock is Logical Biological Unit for Management

Drs. Gary Stauffer, Fishery Biologist, and Dan Huppert, Economist, from the La Jolla Laboratory met with other members of the Anchovy Management Plan Development Team and the Anchovy Advisory Panel at California Department of Fish and Game offices in Long Beach on March 8. The Team presented a paper on the geographical distribution of northern anchovy indicating that the central stock, extending from approximately 38° to 30° N, would be the logical biological unit for management. The northern subpopulation of northern anchovies is fished very lightly, and its population dynamics are poorly understood.

In addition, a descriptive history of the California fishery for anchovy was presented to the Anchovy Advisory Panel, and minor alterations were suggested. During March 16 to 18 Dr. Huppert traveled to Seattle to substitute for Acting Center Director Izadore Barrett, on the Scientific and Statistical Committee (SSC) of the Pacific Regional Fisheries Council. The main topic of the Committee and Council meetings was the "Commercial and Recreational Salmon Fisheries off the coasts of Washington, Oregon and California." The SSC and the Salmon Management Plan Team worked diligently on modifications to the plan. The Council heard reports on public hearings held during the previous month and entertained further comments from the Salmon Advisory Panel. The plan, after modifications agreed to by the SSC and the Team, was approved by the Council.

Anchovy Management Plan Progresses

During March the bio-economic model of optimum yield for the anchovy fishery was nearly completed. Dr. Dan Huppert, Economist, and Mr. Alec MacCall, California Department of Fish and Game, Fishery Biologist at the SWFC's La Jolla Laboratory, have produced a flexible model for evaluating

annual yields under given assumptions about (1) variations in anchovy biomass about expected values, (2) the proportion of juvenile anchovies vulnerable to the reduction fishery, and (3) levels of anchovy harvest by the reduction fishery at Ensenada, Mexico.

In addition to the optimal yield modeling, seasonal factors (including availability, growth, oil and protein content) are being investigated for their potential importance to the fishery management by Dr. Gary Stauffer, Fishery Biologist. Economic aspects of the anchovy fishery, and fish meal industry generally are being analyzed by Dr. Huppert.

The Team has promised to present a preliminary review of the research results and management options to the Anchovy Advisory Panel in Long Beach on April 26. Following this meeting, the Plan Team will modify, edit, and re-write the material--incorporating comments and suggestions from the Advisory Panel as appropriate--for presentation as the first Draft Anchovy Management Plan. This Draft will be unveiled at the Pacific Regional Fisheries Management Council in San Pedro on May 12-13.

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Statistician Keith Parker at the La Jolla Laboratory worked with Dr. Dan Huppert, Economist, on the acquisition and the description of data from commercial landings of anchovy from the California Department of Fish and Game in Long Beach. Statistics on landing of jack mackerel, bonito and bluefin were tabulated for vessels making commercial anchovy landings. The data were subjected to a descriptive analysis, histogram plots, and mean and standard deviation calculations for various categories of landings for inclusion in the anchovy Management Plan.

In a continuing effort to prepare CF&G anchovy logs for catch effort analyses, Mr. Parker met with California Department of Fish and Game biologists in Long Beach to discuss a computer card format developed by Parker and Alec MacCall, CF&G biologist for processing wetfish logbooks. A meeting was scheduled with Mr. Herb Frey of CF&G in April to finalize the format.

Mr. Parker also continued simulation work to describe power of tests to detect non-randomness in a two-dimensional spatial distribution. This study has immediate application in intertidal invertebrate surveys.

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Fishery Biologist John MacGregor reports that he collected rockfish at Tanner Bank during a short cruise aboard the David Starr Jordan. A good series of olive rockfish, starry rockfish, blue rockfish and rosy rockfish were taken in addition to a few specimens of other rockfishes. All fish were taken with hook and line. One attempt was made to take smaller specimens by trawling, but the trawl was lost on the first run.

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Mathematician Joseph Caruso completed the final versions of the effort and sighting record code forms for the aerial marine resources monitoring system. Master copies were prepared for printing. A 44-page documentation package was completed. This report specifies the code instructions for the effort and sighting records. Because of the variety of ways in which pilots record fish sightings, the coding procedure needed to be flexible and yet document the observation in as much detail as possible.

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Other activities of the staff of the Commercial and Recreational Fisheries Research for Management program during March included:

Economist Dan Huppert conferred with Dr. Roy Mendelssohn of the Honolulu Laboratory on March 1-2. Dr. Mendelssohn is eager to apply new operations research methods to a real management situation and is considering the California anchovy fishery as an appropriate case study.

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On March 3-4, Dr. Huppert visited the Tiburon Laboratory to help orient Dr. William Lenarz and newly-hired Ed Ueber, Industry Economist, to the socio-economic work needing to be done in California.

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The California Fish and Game Commission meeting in Los Angeles on March 31 was attended by Drs. Stauffer and Huppert, Jim Squire, Fishery Biologist at the La Jolla Laboratory and Alec MacCall. The Commission heard testimony on proposals to lower and to raise the 1976 to 1977 anchovy quota. Dr. Stauffer gave testimony on the aerial spotter biomass index and the anchovy plan. The Commission concluded by raising the anchovy season quota from 100,000 to 120,000 tons in the southern permit area.

MULTISPECIES COASTAL EASTERN PACIFIC (CalCOFI) PROGRAM

U.S./U.S.S.R. Survey Indicates Presence of Hake Eggs and Larvae in Greater Numbers than in 1976

Radioed reports from Biologists Robert Counts and William Flerx aboard the Soviet research vessel Ogon indicate good progress is being made in conducting the annual U.S./Soviet hake egg and larva survey. Unlike the 1976 survey with the Soviet research vessel Poseydon, hake eggs and larvae are present in about 90% of the CalCOFI tows inside station 90 (240 miles offshore in southern California). The Ogon will survey CalCOFI lines 97, 100, 107, and 110 inside Mexico's 200-mile zone in early April. The Ogon plans to enter San Pedro on April 14 to disembark Messrs. Counts and Flerx.

Oceanic Fisheries Resources Division

PORPOISE/TUNA INTERACTION PROGRAM

U.S. Tuna Vessels Protest Regulations; Remain in Port

At a time of year when U.S. purse seiners are normally fishing for tuna in the eastern tropical Pacific, more than 90% of the U.S. fleet's capacity remains in port. The sequence of events which have brought a virtual end to tuna fishing activities is briefly as follows:

The 1977 tuna fishing year in the eastern tropical Pacific began with the proviso that it was illegal to fish for tuna associated with porpoise. On January 21 U.S. District Judge William B. Enright in San Diego handed down a decision which went into effect on January 25 allowing U.S. tuna fishermen a quota of 10,000 porpoise. The U.S. Court of Appeals in Washington, D.C. however ordered an end to fishing on porpoise on January 28. The 9th Circuit Court of Appeals in San Francisco suspended Judge Enright's order and fishing on porpoise was clearly illegal beyond February 23, 1977. On March 8, 1977, the U.S. Circuit Court of Appeals, Washington, D.C. granted temporary relief to the tuna industry with a quota of 9,972 animals for the period, January 1 to April 30, 1977, or until issuance of the 1977 permit by the National Marine Fisheries Service, whichever came first.

On March 1, the 1977 regulations were published in the Federal Register with a quota of 59,050 porpoise but with no allowance for taking eastern spinner dolphins and only a relatively small number of whitebelly spinner dolphins.

Protesting against the U.S. regulations, most of the U.S. purse seiners ceased fishing and returned to port by the first week of March. As of March 14, 27 U.S. tuna vessels were fishing in the eastern tropical Pacific (mostly small vessels) while 106 vessels remained in port. There were five vessels fishing west of 150° W.

The general permit to allow fishing on porpoise is expected to be issued in mid-April. However, representatives of the tuna industry state that without their being allowed to fish on mixed schools of spotted and spinner porpoise it is not profitable to go fishing. The tuna industry is, therefore, seeking a change in the 1977 regulations to allow some take of eastern spinner dolphins and an increase in the take of whitebelly spinner dolphins.

NMFS Resumes Aerial Survey of Porpoise Populations

After completing extensive repairs, including engine replacement, a Navy-loaned Neptune plane (SP-2H) from the Office of Aircraft Services of the U.S. Department of the Interior, left San Diego at midnight on March 19 to resume the aerial survey of porpoise populations in the eastern

Pacific which had been interrupted halfway through the scheduled pattern in mid-February. In addition to its three man crew the Neptune is carrying six men from NMFS and NOAA: Eric Barham, Scientific Leader, Joseph Powers, Terry Jackson, Richard Charter, William Walker, and Charles Oliver.

The survey party planned to start at the southernmost portions of the track not flown previously, with the first stop to be in Guatemala City. Also to be included on this part of the survey are two track lines out of Lima, Peru. The plane will then work its way northward, flying either every other track line that has already been flown or, if sufficient funds are available, all of the scheduled track lines. The average track line is about 1,100 miles to sea and return, for a total of about 30,000 total nautical miles flown during the survey. After completing the Americas-based track lines, the plane and scientific party will fly, budget permitting, to Hawaii, where they will fly six Hawaii-based lines in their census of the porpoise populations of the Pacific.

Although the aircraft is the primary survey vehicle covering most of the designated ocean area to be surveyed, the remaining areas have been surveyed by the NOAA research vessels, David Starr Jordan from San Diego, and the Townsend Cromwell from Honolulu which returned to port March 8 and March 22, respectively, after being at sea since early January.

Processing of 1976 Porpoise Reproductive Samples Completed

Dr. William Perrin, Leader of the Porpoise Biological Studies at the La Jolla Laboratory, reports that Biological Technicians R. Miller and P. Sloan completed histological examination of reproductive samples from several thousand porpoise examined by NMFS observers aboard commercial seiners in 1976. Life history forms have been filled out for all the specimens. The data will now be keypunched and will form part of the basis for upcoming reports on the biology of the common dolphin, Delphinus delphis, and the striped dolphin, Stenella coeruleoalba, and the structures of the 1976 kills of the spotted and spinner dolphins, Stenella attenuata and S. longirostris in the U.S. tuna purse seine fishery in the eastern tropical Pacific.

TUNA RESOURCES PROGRAM

Reporting Rates By U.S. Seiners Drop Dramatically

During March, only four U.S. seiners participated in the FAX program of the La Jolla Laboratory.

March Reporting Dates

	Weather Observations	XBT Observations	Total
1976	239	16	255
1977	57	0	57
Percent change	-76.2%	-100%	-77.6%

Reporting rates for March dropped dramatically when the majority of the tropical purse seine fleet ceased fishing operations and began the return to port prior to March 1, 1977.

The fishing vessel, Santa Rosa, led cooperating vessels in March by radioing 46 weather observations to radio station, WWD. The Santa Rosa is skippered by John and Noah Gomes.

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During March, NMFS-owned radio facsimile units were removed from three purse seiners that have outstanding applications for change of flag with the Maritime Administration. It is SWFC's policy that NMFS-owned equipment will not be loaned to foreign fishing vessels, or fishing vessels with an outstanding application for change of flag.

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Mr. Richard Evans, Oceanographer, indicates that preparations to convert the SWFC weekly sea surface temperature chart from Fahrenheit to Celsius have been completed. After some minor computer program modification and base chart reformatting, the first chart in degrees Celsius was issued to the tropical purse seine fleet on March 31.

Program to Sample Foreign-Caught Atlantic Tunas During 1976 Reviewed

During March 14-25, Biological Technician Eugene Holzapfel, who is stationed in Puerto Rico, met with Messrs. Al Coan, Gene Tillerson and Gary Sakagawa at the La Jolla Laboratory to review the sampling program during 1976 and to complete plans for the 1977 program. Mr. Holzapfel is stationed in Mayaguez, Puerto Rico to sample foreign-caught Atlantic tunas which are landed in Mayaguez and Ponce.

Species	Number of fish sampled	Tonnage sampled (metric tons)	Tonnage imported (metric tons)	Percent Coverage
Albacore	450	2,700	40,334	7%
Bigeye	227	76	-	-
Skipjack	4,047	9,556	33,509	29%
Yellowfin	5,067	2,808	11,300	25%
Total	9,791	15,140	85,143	18%

Most of the yellowfin tuna sampled (99.7%) were age one fish (29 to 85 cm). Skipjack tuna catches were dominated (46%) by age one fish (31 to 50 cm) and albacore tuna (39%) by ages 4 and 5 fish (77 to 92 cm). All albacore tuna samples were taken from longline catches. Bigeye, yellowfin and skipjack tuna samples were taken from purse seine and baitboat catches.

Species-composition samples were taken of yellowfin tuna landings to determine the amount of bigeye tuna that is mixed in these catches. A total of 197 of these samples was taken in 1976. Approximately 15 to 20% of the reported yellowfin tuna tonnage is actually bigeye tuna. Eighteen species-composition samples were also collected from skipjack tuna catches in which yellowfin tuna was noticed. These samples indicate that approximately 33% of these reported skipjack tonnages were actually yellowfin tuna.

Biological samples of yellowfin and bigeye tunas were taken to determine the amount of error incurred by using external characters to determine whether fish are actually yellowfin or bigeye. Seventy-nine samples were taken by first identifying the fish as yellowfin or bigeye tuna by external characters and then by dissecting the fish and confirming the external identification by inspection of the livers. Analysis of these examinations has not been completed.

A special experiment was conducted in 1976 to determine the amount of bias introduced into our length-frequency samples by rejecting broken fish. Four samples of 25 broken and 25 unbroken fish were taken. Within each sample, the 25 broken and unbroken fish were identified as either yellowfin or bigeye tuna. Results of a chi-square test showed a significant difference in proportion of broken and unbroken fish in one of the four samples. On this basis, it was decided to continue the experiment in 1977.

Plans were made for the 1977 program based on the results of the 1976 program. Length-frequency samples are still to be taken but the number of samples were reduced to allow time for other samples. Species-composition and biological samples will be taken as in 1976. The number of samples of broken and unbroken fish has been increased to 10 pairs. Some otoliths of skipjack tuna for age determination were taken in 1976 and this sampling will be continued in 1977 until 150 to 200 samples are taken.

Preliminary Report on U.S. Vessels that Fished in the Atlantic in 1976 Sent to ICCAT

Tonnages and length-frequency samples from American purse seiners that fished in the Atlantic during the 1976 were collected through NMFS contract by the Inter-American Tropical Tuna Commission. These data were processed and submitted to the International Commission for the Conservation of Atlantic Tunas (ICCAT).

United States, Venezuelan, and Bermudian purse seiners fishing in the Atlantic in 1976 totaled 15 boats: 7 vessels fished in the eastern Atlantic, 5 in the northwestern Atlantic and 3 in the mid-western Atlantic. Total catches by species were:

Ocean Region	(Preliminary) TOTAL CATCH (METRIC TONS) BY SPECIES									
	Yellowfin[1]	Skipjack[1]	Bigeye	Little Tunny	Auxis	Bluefin	Albacore	Other	Total	Number of vessels
Eastern Atl.	1,706	1,757	31					16	3,510	7
North-Western Atl.						1,223			1,233	5
Mid-Western Atl.	444	142							586	3
Gulf of Mexico										
TOTAL	2,150	1,899	31			1,223		16	5,329	15

[1]Include some catches by Venezuelan and Bermudian tuna seiners.

Dominant modal lengths from length-frequency distributions of U.S.-caught tuna were 53 cm for yellowfin tuna, 44 cm for skipjack tuna, and 89 cm for bigeye tuna. Also included in the report were statistics on catch and effort by 1° and 5° square and by ICCAT areas.

Data Bases for Atlantic Tunas Established in Madrid

On February 21, 1977, Mathematician Al Coan of the La Jolla Laboratory, traveled to Madrid, Spain to assist the International Commission for the Conservation of Atlantic Tunas (ICCAT) in establishing a Atlantic tuna computer data base. Data bases created by the La Jolla Laboratory were used as templates.

The bases are written in a data management language of INFONET, a branch of Computer Sciences Corporation. ICCAT is also using INFONET in Madrid.

PACIFIC ENVIRONMENTAL GROUP

OCEAN CLIMATOLOGY AND MONITORING

Platforms of Opportunity Programs - Training Sessions in Marine Mammal Identification Conducted

This month Oceanographer Paul Sund of PEG conducted several training sessions in San Francisco for members of the San Francisco Bay Chapter of the Oceanic Society, Farallon Islands patrol on how to identify various marine mammals. Members are assigned to patrol vessels which make a weekly run from San Francisco to the Farallon Islands to observe birds and their record of sightings of marine mammals en route will be given to Mr. Sund for transmittal to the staff of the Marine Mammal Division at the Northwest and Alaska Fisheries Center in Seattle, Washington.

Mr. Sund also held two training sessions in marine mammal identification for vessel officers and crew and scientific parties from the U.S Geological Survey in Menlo Park, California. The Geological Survey will conduct a number of cruises to the Gulf of Alaska and the Bering and Chukchi Seas in the coming months.

Mr. Sund is presently making preparations for similar training sessions for Alaska fishermen and U.S. Forest Service personnel assigned to duty aboard the Alaska state ferries.

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Brian Jarvis, Physical Science Technician for the Ship of Opportunity project, has been assisting Dr. J. Whipple, Leader of the Physiology Investigation program at Tiburon. Mr. Jarvis has designed a special water sampler that is totally devoid of hydrocarbon materials. It will be used to collect samples for monitoring hydrocarbons in the San Pablo Bay and adjacent areas of North San Francisco Bay. No sampling device is available on the instrument market that met the criteria of the investigation leader. Those few in use elsewhere for petroleum investigations either are too complex - and hence extremely expensive - or contain petroleum-based materials which could contaminate the samples.

OCEAN MODELING AND FORECASTING

Dr. Richard Parrish, Fishery Biologist with PEG in Monterey, has recently made a series of computer runs with a dynamic pool simulation model of the anchovy population off central California. These runs suggest that relatively minor changes in the percentage of fishes spawning could significantly alter the population size and yields from the stock. The hypothesis suggested by these simulations is that changes in the nutritional

state of the central stock, causing alterations in the percentage of younger fish spawning, is a possible mechanism for population fluctuations. The alterations in the nutritional level could in turn be caused by changes in the amount of nutrients in the California Current system, or changes in the total wetfish biomass, or both. Results from these runs were sent to Dr. Gary Stauffer, Fishery Biologist at the La Jolla Laboratory, for use in development of a management plan for anchovy.

TIBURON LABORATORY

PHYSIOLOGY INVESTIGATIONS

Findings Reported on Major Causes of Early Life Stage Mortality of Striped Bass

Dr. Jeannette Whipple, Chief, Physiology Investigations, and Mickey Eldridge, Task Leader at the Tiburon Laboratory, reported on findings from last year's effort to determine the major causes of early life stage mortality of striped bass, providing an information base for the development of hypotheses which will be further tested in the upcoming 1977 spawning season.

Starved striped bass larvae demonstrated the ability to adjust metabolically to the absence of food and conserve their endogenous energy sources. Larvae were able to survive for up to 30 days without food during which time they did not grow. Survival of starved larvae was actually higher than fed larvae until approximately 3 weeks after fertilization. Larvae starved 1 week and then fed survived at the same rate as larvae fed from the beginning. Those starved 2 weeks, however, survived to levels of approximately one-half the fed control larvae.

Fed larvae began to feed 3 days after hatching. All larvae were feeding successfully by 5 days. Most mortality estimates showed a linear decline which stabilized after the oil was consumed (Day 21). Striped bass larvae feeding on Artemia survived the best (up to 60% at metamorphosis) though growth did not appear different from larvae given other prey types. Different prey concentrations did not affect survival or growth until late in development near the time of complete oil globule consumption.

Studies of energetics showed the oil glubule had an important role in the survival, growth and development of both eggs and larvae. Eggs were high in energy content due to the large amount of oil. Embryos and prefeeding larvae relied mainly on yold energy to meet metabolic requirements. After feeding began the oil globule served as a reserve energy source stabilizing growth and development. Effects of different prey types and concentrations were more apparent after oil consumption (18 to 21 days after fertilization).

A conceptual model outlining causative factors of mortality in nine different life stages of striped bass was developed by an interagency committee representing the California Department of Fish and Game, the U.S. Bureau of Reclamation, and the U.S. National Marine Fisheries Service. This model will be changed to a quantitative model at the completion of laboratory experiments.

Electrophoretic examination of various isoenzymes in parents and progeny at different developmental stages proved worthwhile. Significant variation in LDH (Lactate Dehydrogenase) banding patterns was found between individual parents and among eggs and larvae. Methods were developed for examining LDH banding in individual eggs and larvae. These efforts will be expanded next year.

The 1977 experimental season will examine many of the same variables but in greater detail. Outlined by subject area they are:

1. Prey concentration effects on survival and the minimum density needed for normal growth and development.

2. Prey consumption rates at different prey densities.

3. Digestion rates and efficiencies at different prey densities.

4. Effects of different water types and their ionic components on survival.

5. Chemical analyses of metabolic substrates in starved and fed larvae.

6. Delineation of the point-of-no-return.

7. Bioenergetic studies relating to endogenous and exogenous energy sources and their variability with the above test variables.

8. Electrophoretic studies to establish genotypic variation between life stages and parental stocks.

PHYSIOLOGY INVESTIGATIONS

Report Prepared on Results of OCSEAP Petroleum Research

A comprehensive report by Dr. Jeannette Whipple, Chief, Physiology Investigations, and Thomas Yocom, Task Leader, including results of work during the last quarter, was prepared at Tiburon for submission to the OCSEAP office in Juneau, Alaska. The preliminary results of this work are interpreted below. In addition, a manuscript describing a crude oil "solubilizer" has been completed for submission for the Laboratory Director's

approval, entitled: "Simple, Continuous-Flow Systems for Dissolving the Water-Soluble Components of Crude Oil into Sea Water for Acute or Chronic Exposure of Marine Organisms," by Pete E. Benville, Jr., Thomas G. Yocom, and Jeffrey O'Neill. Several other manuscripts are in preparation from this work.

Preliminary Interpretation of Results

The solubilizer dosing apparatus produced both low (chronic) and high (acute) concentrations of the Water Soluble Fraction (WSF), which, as indicated by the monoaromatic concentrations (WSF-MA), were relatively stable over time. WSF-MA variation, due to alteration in flow rates, can be corrected easily in future experiments. The WSF was also emulsion-free. The relative proportion of benzene and toluene in the experimental water column varied with the total concentration of WSF-MA; at higher concentrations benzene predominated, at lower concentrations, toluene. Further experimentation will be done to interpret this result.

When organisms were placed in the system, concentrations were lowered at low flow rates. A portion of this is probably due to uptake by the organisms, but it appears that the increased mucus production by both fish and clams may also affect the water column concentrations. Mucus is apparently adsorbing a considerable portion of the monoaromatics. At sufficiently high flow rates, this effect is minimized. Attempts will be made to measure the WSF-MA adsorption to mucus in future experiments.

Considerable care must be taken to collect animals from pristine (no petroleum contamination) areas, since there was a strong indication from the experiments with littleneck clams that the previous exposure of the organism affected their resistance to the WSF. Because large populations of this clam do not occur in pristine areas, preliminary experiments were done with clams from a relatively polluted area. All future experiments, with all species, will be done with organisms from a pristine area. Control tissue samples of clams from both polluted and pristine areas have not been analyzed yet, to see if there was accumulation in the field. Whether or not such accumulation has occurred, it would appear that the clams from polluted areas were resistant to the WSF, possibly by homeostatic adaptation through enzyme induction.

There was evidence of the ability of the flounder to become more resistant to the WSF in some of the experiments. Surviving juvenile flounder, exposed to 0.155 to 0.841 WSF-MA for 96 hours, did not die subsequently, although exposed to a higher level of 1.64 ppm for 11 days. In preliminary experiments with unexposed flounder, the flounder died at about 1 ppm. Adult starry flounder during gonadal maturation appeared more sensitive than juvenile flounder. When adults were exposed for 96 hours to a relatively low (40-353 ppb) level of WSF-MA, they subsequently died when they were exposed to a higher level of 1 ppm, unlike the juveniles described above.

The levels required to induce mortality in flounder were much lower than for in clams, both collected from a pristine area. Although the 96-hr, LC-50 levels have not yet been calculated, we can say that a constant concentration of from 6-7 ppm WSF-MA was required to kill pristine clams in 96 hrs, while only 1-2 ppm killed the juvenile flounder in 96 hrs.

Measurements of latent mortality, however, showed a different result. No surviving flounder exposed at any level (up to 1.64 ppm) underwent latent mortality after cessation of exposure. Surviving clams, however, underwent considerable latent mortality within 6 days after cessation of exposure.

Behavior of the organisms was altered during exposure, particularly in clams. There appears to be increased irritability and activity in both species at lower levels, with decreasing activity near or above lethal levels due to narcotization. This pattern has been observed previously in many organisms exposed to WSF components of crude oil. Improvement of behavioral observation methods and quantification should clarify these points. Ventilation rate should prove a valuable parameter to monitor the effects on respiration of the flounder.

Both clams and flounders exhibited increased mucus production on being exposed. This will be quantified as a technique is developed. The effect of mucus on decreasing the water concentration of WSF-MA was discussed above, and can be minimized by increased flow rates. The production of mucus indicates a possible negative effect on the protection of the skin and may also result in an energy cost, with possible negative feedback on energy availability for detoxification and depuration processes. Mucus production was increased even at low levels (approx. 100 ppb WSF-MA) and may be an important effect, particularly during long chronic exposures.

Gross morphological effects were observed, although subtle and difficult to quantify. Effects on tissues and organs will be substantiated by histological examination. In the future, electron microscopy can be performed to determine effects at a cellular and subcellular level. Coloration of the liver was affected, probably due to hemorrhaging. The ovaries in exposed fish were also paler due to less blood on the surface, and a "bleaching" of the normally, bright-yellow eggs. It is possible that the uptake of the WSF-MA in the ovaries results in the destruction of the carotenoid-lipo-protein complex in the eggs, and this will be examined further.

There was evidence of egg mortality in the ovaries of females exposed to low (40-353 ppm) levels of WSF-MA; 50-78% of the female ovaries in the experiments were affected. This substantiates our hypothesis that the female prior to spawning and during egg maturation is the most susceptible life history stage, as was previously found in Pacific herring. If so, this has important consequences to population persistence, since the number of eggs surviving to recruitment is reduced by pollutant uptake even before spawning. There was evidence that adult flounder were feeding during egg maturation, at least in earlier stages. They may not stop feeding until

very shortly before spawning. If so, the uptake of petroleum components through the food chain may also be a factor affecting survival of gonadal eggs in the field. There was a preliminary indication of reduced spermatozoan viability in males, and this parameter will be studied further. If more mature flounder are found in "ripe running" condition, another experiment will be conducted to examine delayed effects in spawned eggs and larvae.

Uptake of the WSF-MA by clams and flounders was relatively rapid. Tissue analysis done to date indicates that monocyclic aromatic components reached maximum accumulation levels in most tissues after about one week. However, there was secondary accumulation in many founder tissues after the initial asymptotic levels. This may indicate that metabolic detoxification in the liver was unable to continue at a rate sufficient to break down the components, and they consequently accumulated again, particularly in lipid-rich tissues.

Since exposure levels and the methods of tissue analysis varied between clams (whole tissue homogenates) and flounders (individual tissues: gill, ovary, muscle, kidney, liver and gall bladder (bile)), a direct comparison can not be made. However, it appears that flounder accumulated to higher concentrations from the water WSA-MA, while the clams' tissue concentrations were generally at equilibrium or lower than the water WSF-MA concentrations. Further work must be done to clarify this. Accumulation factors showed that the highest accumulation in flounder was either in lipid-rich tissue (e.g., ovary) or in tissues of organs involved in metabolism of the monoaromatics (e.g., liver). Accumulation in such tissues was up to three orders of magnitude greater than the water column. Other compounds (unidentified) also accumulated in the tissues of the flounder. Further work will be done on these compounds, as well as analysis for polycyclid aromatics and other compounds which may be accumulating.

Depuration of the WSF-MA was relatively rapid in both clams and flounders; nondetectable levels occurring within a few days after cessation of exposure. Some of the unidentified compounds persisted longer, however, and in some cases toluene persisted at relatively high levels. Depuration in ovaries of exposed female flounder has not yet been determined.

In conclusion, these experiments demonstrated 1) that our basic experimental approach is feasible, 2) that stable exposure concentrations can be achieved, 3) that the approximate time to maximum accumulation of the WSF-MA is 1-2 wks, and 4) there are several potential effects that can be measured during long-term, chronic exposure from both water column and contaminated food.

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Results were analyzed this month from a San Francisco Bay Bunker-C oil spill which occurred the first week of February just after the winter's largest Pacific herring spawn. Members of the Physiology staff conducted

a field investigation of the spill, collecting water samples and herring eggs from three different areas along the shoreline of the Bay. Complete chemical analyses of the water samples have not been completed, but initial examination for six monocyclic aromatics showed there were none in solution. Eggs were incubated and hatched in the laboratory to assess impact on the spawn. Although the eggs were partially hatched, eggs from oil-covered areas had lower hatching success, and heavily exposed eggs had larvae with abnormalities, which died soon after hatching.

FISH COMMUNITIES INVESTIGATIONS

Ecological Cycles Defined at Santa Catalina Island

In the continuing analysis of collections and observations made during their three years at Santa Catalina Island, Dr. Edmund Hobson, Leader of the Nearshore Recreational Fish Communities Task, and Fishery Biologist Tony Chess of the Tiburon Laboratory, have documented the occurrences of fishes, benthic algae, and related organisms over two years at a study site representing the low fields of benthic algae growing from polychaete tubes in sand, a widespread nearshore habitat. Three species of benthic algae predominated: Dictyopteris zonaroides, Pachdictyon coriaceum (both always present), and Desmarestia viridis (absent in winter). During both summers the algal field covered 80% of the study area, but during both winters the coverage decreased to 20%. Despite the similar coverage between the two years, there were major differences in the relative abundances of these three major species from one year to the next. Most significant, however, during one summer 75% of the algal field was covered by the epiphitic alga Acinotospara nicholsonae, while during the second summer this epiphyte was insignificant in this habitat, but grew heavily over Sargassum muticum, another alga, in an adjacent habitat. Significantly, when the epiphyte covered most of the field, the fish species that prey on organisms living on Dictyopteris, Pachydictyon and Desmarestia largely abandoned the area. Apparently, their prey, though as numerous as at other times, were unavailable to them under the overlying epiphyte. These studies underscore problems with unrepeated base-line studies, or assessments of the biota that do not recognize all interrelated components of the environment.

Rockfish Task Economist Visits California Ports

Edward Ueber, Economist with the Rockfish Analysis Task at Tiburon, visited California ports to establish contact with individuals involved with the rockfish fishery. Through this trip, and the earlier trip to northern California ports, Mr. Ueber has become acquainted with fishermen, processors, California Fish and Game personnel, and Sea Grant agents. Certain of the processors, and others, expressed interest in participating in Mr. Ueber's marketing experiments, and he was invited by several fishermen to board their vessels for short trips to become familiar with local fishing operations.

FISHERIES DEVELOPMENT INVESTIGATION

Plans Made for Experimental Fishery on Euphausid Shrimp

Mr. Susumu Kato, Leader of the Coastal Fisheries Technique Development Task at Tiburon Laboratory, reported that he traveled to Moss Landing to board F/V Lady Olga March 24 and attempt experimental fishing and processing of euphausid shrimp. Bad weather delayed the arrival of the vessel, and subsequent gales prohibited fishing. Mr. Kato has rescheduled his trip on the Lady Olga for a later date.

The bids for design and construction of a new rockfish midwater trawl have been received and evaluated. The contract will be awarded in early April. Several fishermen had indicated their interest in trying midwater trawling for rockfish, and plans are to place the trawl aboard selected vessels at several ports along the California coast.

Young Silver Salmon Received for Salt Water Rearing

Mr. Roger Green, Fishery Biologist, reported that 30,000 coho salmon were received from Mad River Hatchery and introduced into one salt water pen at the Tiburon Laboratory. The fish are those held over from the delivery scheduled for last August because of their slow growth and failure to reach smolting stage last year. A sample of 50 fish showed a mean size of 28 gm (16 per lb.). Mortalities following transfer were 1,841 fish in the first week, 356 in the second and 93 in the third. The heavy initial mortality was in the smaller sizes of fish that had not smolted yet and were killed by the salt water. The remaining fish appear to be in good health and feeding at the expected rate of 3% body weight daily.

Mr. Green also reported a silver salmon tag return from the release of fish in 1975. The tag was found by a biologist of the Pt. Reyes Bird Observatory on the southeast Farallon Island on a sea lion rookery. The island is 26 miles offshore of the Golden Gate. The biologist theorized that the tag was deposited in the feces or regurgitation of a sea lion or gull.

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Lt. Ed Gullekson, NOAA Corps Officer assigned to Tiburon, reported completion of repair to all the nets. He started construction and modification of an old net into a fish trap. Data from the last tagging have all been sorted and listed by computer, and a complete numerical listing from last fall's king salmon releases is now available. As return data come in, they are deposited in the computerized file.

Work Continues on History of Fishing Methods in California

Ms. Susan Smith of the Tiburon Laboratory continued work on the history of tackle and method changes in California's marine recreational fisheries. During March, she concentrated on tracing developments in the striped bass fishery--a fishery whose partyboat segment has undergone considerable methodological changes since the mid-1950's. The most dramatic changes have been the switch from surface trolling and baitfishing to deepline trolling, and then to deepwater live bait drifting.

Angler's Guide to the United States Pacific Coast

Publication of the Angler's Guide has been further delayed due to additional revisions that have to be made on the fishing charts.

PUBLIC AFFAIRS

La Jolla Laboratory

Mr. John Everett, Leader of the Porpoise/Tuna Interaction program at the La Jolla Laboratory, conducted a seminar on "The Porpoise/Tuna problem as seen through the eyes of a government researcher" at the new Van Camp research facility in Sorrento Valley. The presentation and discussion with about 30 Van Camp managers and researchers went well, often with spirited discussion of the issues.

Tiburon Laboratory

March 25 - A group of upper division and graduate students, together with Dr. Joe Sullivan and Dr. George Allen, from Humboldt State University, toured the Tiburon Laboratory.

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Press Release to Coast-Wide News Sources from the La Jolla Laboratory

March 8 - U.S. Cooperates with Soviets in Fisheries Survey

HONORS AND AWARDS

Dr. R. Lasker, Leader of the Coastal Fisheries Resources Division at the La Jolla Laboratory, has been named as the Ocean Sciences Board representatives to the Post-IDOE Planning (PIP) Board of the National Science Foundation and will attend the IDOE biological Oceanography Workshop in Rhode Island in April.

Mr. Henry Orr, Scientific Illustrator at the La Jolla Laboratory, and his wife have been chosen to receive a citation in the 1976 National Volunteer Activist Awards competition. Mr. and Mrs. Orr will receive a certificate of recognition and are one of 68 semi-finalists now being evaluated for consideration as a national winner for this year's program. The National Volunteer Activist Awards are sponsored by the Germaine Monteil Cosmetiques Corporation.

SEMINARS

La Jolla Laboratory

March 14 - Dr. Angeles Alvarino, Fishery Research Biologist, discussed, "The Malaspina expedition and the fishes of the North American Pacific."

Honolulu Laboratory

March 15 - Dr. Robert L. Pyle, Manager, Satellite Field Service Station, Honolulu National Environmental Satellite Service, spoke on "Operational Applications of NOAA Environmental Satellites in the Pacific."

Tiburon Laboratory

- Dr. Victor L. Loosanoff continued his series of mariculture seminars at the Tiburon Laboratory. On March 4 his topic was "Mariculture as Exemplified by Shellfish Cultures." On March 18 he spoke on "Shellfisheries in France and other European Countries."

TRAINING

February 27 - March 4 - Administrative Assistant Barbara Engstrand, La Jolla Laboratory, was in San Francisco to attend a GSA-sponsored course on small purchases.

March 15-16 - Pete E. Benville of the Tiburon Laboratory, "Glass Capillary Chromatography and Specific Detector Technology."

21-23 - Rita J. Ziegler of the Tiburon Laboratory, "Better Office Skills and Services."

VISITORS

Honolulu Laboratory

March 1 - Dr. G. Tomczak, FAO, Rome, Italy.

3 - Dr. H.R. Schmittou, Auburn University, Alabama;
Dr. William F. Royce, Seattle, Washington;
Dr. James A. Storer, Special Assistant for International Fisheries Program, NOAA, Rockville, Maryland.

4 - Dr. Lucian M. Sprague, World Bank, Washington, D.C. en route to the Philippines.

- Mr. Glenn Tanoue of Tropics Produce.

- Dr. Dennis Devaney, Curator, Invertebrate Department, Bishop Museum, Honolulu. Dr. Devaney is interested in examining the invertebrate collection at the Honolulu Laboratory.

17 - Mr. Robert E. Beck, NOAA HQ (EMx1) and RADM Harley D. Nygren, Director, NOAA Corps (NC), Washington, D.C., visited with Acting Director Barkley.

21 - Mr. Tamio Otsu was visited by Mr. Russ Smith, a west coast albacore fisherman.

25 - Ms. Sharman Brown, University of Hawaii Sea Grant, visited Mr. Tamio Otsu to discuss automatic fishing machines.

28 - Mr. Carmen Blondin, Office of International Fisheries, NMFS, Washington, D.C. and Ms. Katherine Clark-Bourne, Office of Fisheries Affairs, Department of State, Washington, D.C.

- Messrs. Harry English and R.W. Ellis of the White Fish Authority, United Kingdom.

La Jolla Laboratory

March 4 - Dr. G. Tomczak, FAO, Rome at the Center to meet with Drs. Fox and Sakagawa.

8-10 - Mr. Freel Hubbard and Ms. Candace Turner of the NASO office in Seattle, to meet with Acting Center Director Barrett.

9-11 - Administrative Officer Mary Lynne Godfrey of the Honolulu Laboratory here for the purpose of administrative coordination between the Honolulu Laboratory and the Southwest Fisheries Center.

March 10 - Dr. Jorge Carranza/Fraser and Mr. Daniel Lluch, Instituto Nacional de Pesca, Mexico City and Mr. Ronald Keir, FAO, Mexico City.

24 - Mr. David Cacic, Michigan State University, East Lansing, Michigan.

March 28 - April 1 - James Zuboy, Southeast Fisheries Center and Robert Otto, NMFS, Washington.

Pacific Environmental Group

March 29 - Robert Huffer, Scripps Institution of Oceanography, La Jolla, California.

- Valerie Loeb, Scripps Institution of Oceanography, La Jolla, California.

Tiburon Laboratory

March 1 - Wm. G. Dary, Consultant, Wilsonville, Oregon.

3 - Dr. Dan Huppert, NMFS, SWFC, La Jolla, California.

- Michael J. Gregory, University of Kiel, W. Germany.

4 - Emil J. Smith, Jr., California Department of Fish and Game, Sacramento, California.

- Clark Blunt, California Department of Fish and Game, Roseville, California.

- Walter A. Dahlstrom, California Department of Fish and Game, Menlo Park, California.

8 - Barry Faulkner, Petaluma, California (commercial fisherman).

10 - Thomas P. Scott, Verd-A-Ray Corp., San Rafael, California.

15 - Don Aasted, NMFS, SWFC, Honolulu, Hawaii.

22 - Dr. John Naughton, NMFS, Honolulu, Hawaii.

- Floyd Anders, Gary Smith, Jim Slawson, Bob Hoffman, NMFS, Terminal Island, California.

MEETINGS AND TRAVEL

March 2 - Dr. Yung C. Shang, Economist, Hawaii Institute of Marine Biology, University of Hawaii, met with Mr. R. Shomura, Director of the Honolulu Laboratory, to discuss fishery economics studies.

2-3 - Dr. Lasker and Mr. Barrett, Acting Center Director, were part of the delegation which met with Dr. Jorge Carranza, Director, and his staff at Instituto Nacional de Pesca, in Mexico City to discuss cooperative fisheries work in CalCOFI.

3-11 - Lt. Terry Jackson, NOAA Corps Officer detailed to the La Jolla Laboratory, was in Honolulu to discuss porpoise research at the Honolulu Laboratory and the University of Hawaii and to conduct an aerial survey on a return Navy flight to San Diego.

7 - Mr. Ed Ueber of the Tiburon Laboratory traveled to Eureka to meet with fishermen, processors, California Fish and Game, and Sea Grant agents in connection with the rockfish fishery.

7-12 - Dr. M. Laurs of the La Jolla Laboratory traveled to the Honolulu Laboratory to complete work on an albacore growth manuscript with Dr. Jerry Wetherall.

8-10 - Dr. William Fox. Leader of the Oceanic Fisheries Resources Division at the La Jolla Laboratory, traveled to Washington to participate in Senate hearings on amendments to the Marine Mammal Protection Act of 1972.

9-11 - Mr. D. Mackett, Planning Officer, SWFC, in St. Petersburg, Florida to attend a Data Management Committee meeting.

10-12 - Mr. Shomura, together with Mr. Wilvan G. Van Campen, Executive Director, Western Pacific Regional Fisheries Management Council (WPRFMC), departed for Midway Islands to meet with Capt. D. H. Fischer, Commanding Officer, U.S. Naval Facility, Midway, to discuss implementation of 200-mile fishery conservation zone and to review Honolulu Laboratory's long-term survey and assessment of NWHI.

14-16 - Dr. Richard Parrish of PEG traveled to Long Beach, California to visit California Fish and Game to arrange contract for digitizing fishery data.

March 15-16 - Mr. Bernard Ito, Honolulu Laboratory, attended the histamine research meetings in the conference room of the Honolulu Laboratory called by Dr. Tom Nakayama of the UH Food Science and Technology Department.

15-18 - Dr. Dan Huppert, Economist at the La Jolla Laboratory, was in Seattle for the meeting of the Pacific Council's Scientific and Statistical Committee.

15-24 - Mr. Shomura traveled to Tokyo and Shimizu, Japan, to meet with Japanese officials and scientists to discuss billfish statistics and data.

16 - Tiburon Laboratory Director Norman Abramson and his Administrative Officer, Mrs. Walburga Giguere, met in San Francisco with Messrs. Charles Fuller, HEW (Office of Federal Property Assistance), Tom Scott and Fred Muse, GSA, and Graham Mathes, NASO, for discussions regarding the excess property.

17 - The next day Abramson and Mrs. Giguere met at the Tiburon Laboratory with Mr. Charles Fuller, HEW, Mr. Graham Mathes, NASO, Mr. Dean Parnell and Dr. Ken Drawford, San Francisco State University, and their attorney, Ms. Doris Lee, to define excess property requirements either for inclusion into the final deed or for informal common services agreements.

17-18 - Acting Center Director I. Barrett in Tiburon to discuss administrative and research matters with Mr. Abramson, Director, Tiburon Laboratory.

20-23 - Dr. R. Lasker, Leader of the Coastal Fisheries Division traveled to Raleigh, North Carolina to present a seminar at North Carolina State University and to New Bern, North Carolina, to visit the Beaufort Laboratory.

22 - Mickey Eldridge, Jack School and Dana Eng of the Tiburon Laboratory visited with Dr. Mike Hartman of the University of California Bodega Marine Laboratory with regard to various aquaculture methods and materials.

22-23 - Dr. M. Laurs of the La Jolla Laboratory traveled to Monterey and San Francisco to confer with Se a Grant Marine Advisory people and also people from the National Environmental Satellite Service regarding albacore advisory operations.

22-24 - Messrs. David Mackett and Fred Kellenberger, Planning Officer and Data Systems Manager, respectively, from the SWFC, discussed (1) enforcement information systems under extended jurisdiction law with Region personnel and (2) data management with Center personnel at the Honolulu Laboratory.

March 25 - Dr. G. Sakagawa, Leader of the Tuna Resources program at the La Jolla Laboratory, traveled to Lafayette, California to meet with representatives of Tetra Tech on contract results and progress.

27-29 - Mr. Gunter Seckel, Oceanographer, PEG, traveled to Boulder, Colorado, to attend a meeting to draft a preliminary PDP for NOAA-wide ocean climate research.

28 - Mr. Ed Ueber, Economist at Tiburon, traveled up the coast from southern California visiting California ports and becoming acquainted with fishermen, processors, California Fish and Game and Sea Grant agents involved with the rockfish fishery.

29 - Mickey Eldridge, Jack Scholl and Dana Eng of the Tiburon Laboratory visited the California Department of Fish and Game Central Valleys Hatchery at Elk Grove, California to discuss the 1977 striped bass spawning season and the upcoming planned experiments.

March 30 - April 1 - Acting Center Director I. Barrett and D. Mackett, Program and Planning Officer for the SWFC, attended the Southwest Region Management meeting for discussion of philosophy, programs, and resource problems of the Region and areas of interaction with the Center.

March 28 - April 1 - Billfish Workshop, SWFC Auditorium.

PERSONNEL

March 1 - Lt. Ed Gullekson, NOAA Corps - Promotion - Tiburon Laboratory

13 - Robert Fountain, Biological Technician - Temporary Appointment - La Jolla Laboratory

14 - Bruce Blackwell, Mathematical Aid (Student) - Appointment - La Jolla Laboratory.

- Barry Moore, Biological Aid - Temporary Appointment - Tiburon Laboratory.

- Mary Liu, Clerk-Typist (Student Aid) - EOD - Pacific Environment Group, Monterey

March 15 - Stanley D. Smith, Biological Technician (Fisheries) - Temporary Appointment & Resignation March 22 - Honolulu Laboratory.

17 - Kristin L. Stahl, Biological Technician (Fisheries) - Temporary Appointment - Honolulu Laboratory.

27 - Antonio C. Munoz, Maintenanceman - CC Appointment, Part-Time - Tiburon Laboratory.

28 - Stephen Fitzgerald, Library Assistant - Temporary Appointment - Honolulu Laboratory.

- June Favorite, Math Aid, - EOD - Pacific Environmental Group, Monterey.

- Paul Fiedler, Biological Technician - Temporary Appointment - La Jolla Laboratory.

- Henry Orr, Scientific Illustrator - Conversion to Full Time - La Jolla Laboratory.

- John Brown, Electronics Engineer - Promotion - La Jolla Laboratory.

- Richard Charter, Biological Technician - Promotion - La Jolla Laboratory.

- William Flerx, Biological Technician - Promotion - La Jolla Laboratory.

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